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New species of Uredineae—VI

JOSEPH CHARLES ARTHUR

The following fifteen species of rusts are in part new discoveries, and in part well known forms that have not before been specifically named and characterized. They are placed on record in order to facilitate the work of preparation for the systematic treatment of the order in the North American Flora, the final parts of which are now being written. The kindness of those who have contributed specimens is much appreciated. The hearty coöperation of numerous correspondents tends to insure a reasonably full treatment in the forthcoming work.

An error in the preceding number of this series may be pointed out here. The type specimen of *Uredo Holwayi* (Bull. Torrey Club 33: 518. 1906) is on *Tsuga heterophylla* (Raf.) Sarg. The error was due to a confusion in the mind of the writer of the characters belonging to the two species of hosts. *T. heterophylla* is the lowland hemlock, which was formerly referred to the eastern *T. canadensis*. Both it and the alpine hemlock are found in the vicinity of Glacier, B. C. Professor Holway, who was in the Selkirks from July to September of 1907, reported the rust at the time very abundant on the lowland species, but rare on the other. He has sent a specimen on *T. Mertensiana*, collected at Glacier, B. C., August 18, 1907.

***Puccinia cinerea* sp. nov.**

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, oblong, small, 0.1–0.3 mm. wide by 0.5–1.5 mm. long, tardily naked, pulverulent, orange-yellow, ruptured epidermis conspicuous; urediniospores broadly ellipsoid, 18–23 \times 23–29 μ , wall pale-brown, about 1.5 μ thick, finely and inconspicuously echinulate, pores 5 or 6, scattered.

III. Telia compound, amphigenous, scattered, oblong, small, 0.1–0.2 mm. wide by 0.5–1 mm. long, long covered by the epidermis, cinereous, surrounded by a thin stroma; teliospores oblong or oblong-clavate, irregular by compression, 16–21 \times 40–60 μ , wall dark cinnamon-brown, 1–1.5 μ thick, thicker at apex, 3–5 μ , smooth; pedicel short, tinted.

On *Poa nevadensis* Vasey, Fort McKinney, Wyoming, August, 1898, *Williams & Griffiths* (Griff. W. Am. Fungi 355; type); *P. arida* Vasey, Wood River, Nebraska, July 28, 1906, *J. M. Bates* 3930, Loup City, Nebraska, June 22, 1907, *J. M. Bates*; *Poa* sp., Billings, Montana, September, 1898, *Williams & Griffiths* (Griff. W. Am. Fungi 355a); Piedmont, Wyoming, August 4, 1901, *L. H. Pammel* 2179. The species resembles *Puccinia epiphylla* (L.) Wettst. (*P. Poarum* Niels.), but in the uredinial stage is readily distinguished by the slightly larger spores and absence of paraphyses, and in the telial stage by the more pronounced stroma, paler sori and larger teliospores. Rev. J. M. Bates has found it a number of times growing intermixed with *Oxygraphis Cymbalaria* (Pursh) Prantl, bearing aecia, and suggests that the two forms may be genetically related.

***Puccinia perminuta* sp. nov.**

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous or only epiphyllous and caulicolous, scattered, oval, small, 0.1–0.3 mm. long, tardily naked, pale-yellow, pulverulent, ruptured epidermis noticeable; urediniospores globoid or broadly ellipsoid, $15-18 \times 16-22 \mu$, wall very pale-yellow, thin, 1μ or less, sharply echinulate, pores about 6, scattered, obscure.

III. Telia amphigenous or only epiphyllous and caulicolous, oval, small, 0.1–0.3 mm. long, often confluent, covered by the epidermis, blackish; stroma usually wanting; teliospores oblong, $12-16 \times 25-39 \mu$, slightly or not constricted at septum, obtuse at both ends, wall chestnut-brown, smooth, thin, $1-1.5 \mu$, much thickened above, $5-10 \mu$, concolorous; pedicel very short, colored.

On *Agrostis hyemalis* (Walt.) B.S.P., Sugar Grove, Ohio, September 23, 1905, *W. A. Kellerman* 4299 (type); Houston, Texas, April 17, 1869, *H. W. R[avenel]*, uredinia only (specimen in herbarium of U. S. Department of Agriculture, said to be on *Trichodium*); *A. perennans* (Walt.) Tuckerm., Durbin, Pocahontas County, West Virginia, August 28, 1902, *W. A. Kellerman* 3960. The species differs from *P. Agrostidis* Plow. in the smaller spores of both sorts, and a less development of stroma, and in other less prominent characters. No one has yet made a suggestion as to its probable aecial connection.

***Puccinia praegracilis* sp. nov.**

O. and I. Pycnia and aecia not definitely known.

II. Uredinia amphigenous, scattered, oblong, small, 0.1–0.2 mm. wide, by 0.2–0.3 mm. long, soon naked, pale-yellow, pulverulent, ruptured epidermis barely noticeable; urediniospores broadly ovoid, $16-19 \times 18-21 \mu$, wall rather thin, about 1μ , pale-yellow, closely and minutely echinulate, pores about 6, scattered, obscure.

III. Telia amphigenous, oblong or linear, 0.1–0.3 mm. wide, by 0.3–1 mm. long, irregularly confluent, covered by the epidermis, purplish-black; stroma none; teliospores oblong or linear-oblong, $12-13 \times 30-42 \mu$, slightly or not constricted at septum, obtuse or truncate at both ends, coronate with short tubercles above, wall golden-brown, smooth, thin, 1μ , somewhat thicker above, $2-4 \mu$ exclusive of tubercles, and darker-colored; pedicel broad, very short, concolorous.

On *Agrostis Thurberiana* Hitchc., Glacier, British Columbia, 1200 meters, September 5, 1902 (type); July 29, 1907, *E. W. D. Holway*. This species differs in its smaller and more delicate uredinio- and teliospores from *Puccinia Rhamni* (Pers.) Wettst. (*P. coronata* Corda), to which it bears considerable resemblance, and from other species on *Agrostis* by the coronate teliospores. Collections were made at three or four localities, in the same general region. In each case the rust grew in connection with aecia on *Limnorchis stricta* (Lindl.) Rydb. (*Habenaria gracilis* S. Wats.), and the collector believes the two forms are genetically related. The first collection is accompanied by this note: "This grew adjoining the *Habenaria* aecidium, and nowhere else. There were two localities, one a high meadow where it was quite abundant, and another where only a half dozen plants of the *Habenaria* grew, and between these plants the rust was found, the orchid leaves still showing the old aecidia."

***Puccinia Chaetochloae* nom. nov.**

The uredinal stage of the species was described in the previous paper of this series. Since then the telia have been detected by Dr. Bessey in a specimen gathered at Miami, Florida, January 16, 1907, which makes it possible to transfer the rust to the genus *Puccinia*. It may be described as follows:

II. *Uredo Chaetochloae* Arth. Bull. Torrey Club 33: 518. 1906.

III. Telia amphigenous, few, scattered, oblong or linear, small,

0.1 mm. wide by 0.5–1 mm. long, tardily naked by a longitudinal slit; teliospores ellipsoid, often irregular, $23\text{--}26 \times 32\text{--}37 \mu$, rounded at both ends, slightly or not constricted at septum, wall chestnut-brown, concolorous, thin, $1\text{--}1.5 \mu$, rarely thickened slightly at apex, smooth; pedicel colored, short, often obliquely attached.

On *Chaetochloa macrosperma* Scribn. & Merr., Miami, Florida. Telia collected January 16, 1907, *Ernst A. Bessey* 59.

***Puccinia panicicola* sp. nov.**

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous, numerous, scattered, oval, 0.1–0.3 mm. wide by 0.2–0.4 mm. long, soon naked, pulverulent, dark cinnamon-brown, ruptured epidermis noticeable; urediniospores broadly ellipsoid or obovoid, $23\text{--}25$ by $26\text{--}30 \mu$, wall dark cinnamon-brown, rather thick, 1.5μ , closely and strongly echinulate-verrucose with blunt points, pores 3–4, sometimes only 2, equatorial.

III. Telia not seen.

On *Panicum molle* Sw., Santiago de las Vegas, Cuba, March 1, 1907 (type), March 6, 1903, *C. F. Baker*; Cuautla, State of Morelos, Mexico, October 12, 1898, *E. W. D. Holway* 3045; *Panicum hebotes* Trin., Jalapa, State of Veracruz, Mexico, October 5, 1898, *E. W. D. Holway* 3083. No teliospores have been seen by the writer, but a few were seen by the collector, according to a note in the packet of the last-named collection. The species is much like *P. esclavensis* D. & H., but the urediniospores are smaller, more strongly sculptured, and have thinner walls with fewer pores.

***Puccinia quadriporula* sp. nov.**

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, roundish or oblong, 0.4–1 mm. long, early naked, somewhat pulverulent, cinnamon-brown, ruptured epidermis inconspicuous; urediniospores broadly ellipsoid or globoid, $17\text{--}21 \times 22\text{--}26 \mu$, wall cinnamon-brown, medium thin, $1.5\text{--}2 \mu$, finely and evenly echinulate, pores 4, equatorial.

III. Telia hypophyllous, scattered, roundish or oblong, 0.4–1 mm. long, soon naked, somewhat pulvinate, blackish-brown, ruptured epidermis noticeable; teliospores clavate-oblong, $16\text{--}21 \times 42\text{--}48 \mu$, usually rounded above, rounded or often narrowed below, wall chestnut-brown, concolorous, rather thin, $1\text{--}1.5 \mu$, thicker at apex, $9\text{--}10 \mu$, smooth; pedicel slightly tinted, about one-half length of spore.

On *Carex vulgaris* Fries (*C. Goodenovii* J. Gay), Isle au Haut, Maine, September 25, 1899, *J. C. Arthur* (type); *C. spectabilis* Dewey, Glacier, British Columbia, August, 1907, *E. W. D. Holway*. Only one species of *Puccinia* on *Carex* possessing four equatorial pores in the urediniospores has heretofore been recognized from North America. That species, *Puccinia minuta* Diet., on *C. verrucosa* from Alabama, is easily distinguished by its much larger and more nearly globose urediniospores, and other less evident characters. The two widely separated stations indicate that it is not uncommon in the northern regions, although little material is yet available for study.

***Puccinia minutissima* sp. nov.**

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, round or nearly so, 0.2–0.3 mm. across, early naked, chestnut-brown, pulverulent, ruptured epidermis conspicuous; urediniospores globoid or broadly ellipsoid, very small, $13-16 \times 16-20 \mu$, wall chestnut-brown, medium thick, $1-1.5 \mu$, finely echinulate, pores 2, in upper part, evident.

III. Telia hypophyllous, numerous, scattered, round or oblong, 0.2–0.3 mm. wide by 0.2–0.7 mm. long, early naked, pulverinate, blackish-brown, ruptured epidermis conspicuous; teliospores oblong-clavate, $15-22 \times 42-64 \mu$, slightly constricted at septum, apex rounded or obtuse, narrowed below, wall dark chestnut-brown, concolorous, smooth, $1-1.5 \mu$ at sides, much thickened above, $9-13 \mu$; pedicel one fourth length of spore or less, firm, tinted.

On *Carex filiformis* L., in sphagnum swamp, Lansing, Michigan, September 5, 1885, *J. C. Arthur* (type); in a sphagnum bog, London, Ontario, Canada, October, 1898, *J. Dearness* (Ellis & Ev. Fungi Columb. 1382); Kewanna, Indiana, October, 1893, *L. M. Underwood* (part of some specimens in Ellis & Ev. Fungi Columb. 258). The species is especially characterized by the unusually small urediniospores, but is also well marked in other respects.

***Prospodium bahamense* sp. nov.**

O. Pycnia unknown.

II. Urediniospores intermixed with the teliospores, few seen, broadly ellipsoid or globoid, $18-23 \times 24-27 \mu$, walls golden-brown,

not noticeably laminate, medium thick, $2.5-3\mu$, sparsely and strongly verrucose, pores 2, opposite and equatorial.

III. Telia hypophyllous, minute, scattered, or crowded into seemingly pulvinate groups of 0.2–1 mm. across, early naked, blackish, ruptured epidermis not noticeable; paraphyses numerous, peripheral, united at the bases, terete, $9-10 \times 55-64\mu$, acuminate, somewhat incurved, wall firm, about 2μ thick, dark chestnut-brown, smooth; teliospores few in a sorus, broadly ellipsoid, $24-27 \times 32-39\mu$, rounded at both ends, slightly constricted at the septum, wall chocolate-brown, rather thick, $3.5-4.5\mu$, gelatinous layer golden-yellow, not conspicuous except at apex and sometimes at base where it produces an umbo-like thickening of $2-3\mu$, closely and rather coarsely verrucose; pedicel pale amber-colored throughout, once to once and a half length of spore, with one whorl of rather large, much branched appendages, near the base.

On *Tecoma bahamensis* Northrop, New Providence, Bahamas, March 12–24, 1907, *Elizabeth G. Britton* 6596. A very distinct species, intermediate in the character of its appendages between *P. appendiculatum* and *P. Amphilophii*. The paraphyses are particularly noteworthy. Being large and stout, and very dark-colored, they are especially conspicuous. But they are unique in the way in which they adhere at the bases to form a circle about the spores. The sorus may be readily separated as a whole from the tissue of the host, with the spores in place. It then appears campanulate, like a partially opened flower, borne on a slender, pale pedicel, which is formed of the greatly compressed portions of the paraphyses and spore-stalks where they pass through the epidermis.

Calliospora Petalostemonis sp. nov.

O. Pycnia chiefly hypophyllous, preceding or accompanying the telia, numerous, scattered, conspicuous, golden-yellow becoming brown, subcuticular, conical, $80-110\mu$ wide, about half as high; ostiolar filaments $30-50\mu$ long.

III. Telia hypophyllous, scattered, small, roundish, 0.3–0.6 mm. across, chocolate-brown, somewhat pulverulent, ruptured epidermis somewhat noticeable; teliospores ellipsoid, $23-29 \times 35-45\mu$, rounded at both ends, slightly or not constricted at septum, wall laminate, inner layer light chestnut-brown, medium thick, $2-2.5\mu$, pores two in each cell, lateral and opposite, outer layer gelatinous, pale-yellow, rather thin, $1-1.5\mu$, very finely and rather sparsely verrucose; pedicel colourous, about 6μ in diameter, short and largely deciduous, not swelling in water.

On *Petalostemon oligophyllus* (Torr.) Rydb., Pecos, New Mexico, 1903, *T. D. A. Cockerell*. Both the pycnia and telia of this species are most abundant and conspicuous. It differs from *Uropyxis Petalostemonis* (Farl.) DeToni in the absence of uredinia and paraphyses, and in other less evident characters.

***Aecidium Petalostemonis* Kellerman & Carleton, sp. nov.**

O. Pycnia amphigenous, sparsely disposed in indefinite groups, inconspicuous, subepidermal, globoid, 70–100 μ in diameter by 90–100 μ high; ostiolar filaments 30–45 μ long.

I. Aecia amphigenous, gregarious, irregularly arranged in indefinite groups, on discolored spots occupying all or part of a leaf, short, about 0.2 mm. across; peridium colorless, margin somewhat lacerate, spreading or somewhat recurved, peridial cells rhomboidal, overlapping, outer wall rather thick, 5–7 μ , not conspicuously striate, smooth, inner wall medium thin, 3–4 μ , rather finely verrucose; aeciospores broadly ellipsoid or globoid, 18–24 \times 20–28 μ , wall colorless, rather thin, 1–1.5 μ , evenly and rather finely verrucose.

On *Petalostemon candidus* (Willd.) Michx., Manhattan, Kansas, June, 1886, *W. A. Kellerman* (Ellis & Ev. N. Am. Fungi 1845), Lincoln, Nebraska, May 27, 1902, *John L. Sheldon*; *P. purpureus* (Vent.) Rydb. (*P. violaceus* Michx.), Manhattan, Kansas, June 6, 1887, *Kellerman & Swingle*, Stockton, Kansas, June 6, 1906, *E. Bartholomew* (Bartholomew, Fungi Colum. 2296); *P. villosus* Nutt., Merriman, Nebraska, July 11, 1899, *J. M. Bates*. It is also recorded on *P. multiflorus* Nutt. from Kansas (Trans. Kansas Acad. Sci. 10: 91. 1887), and on an undetermined species of *Petalostemon*, above Big Horn, Wyoming (Proc. Davenport Acad. Sci. 7: 252. 1889). This name was used by Kellerman and Carleton over twenty years ago in a "Second list of Kansas parasitic fungi, together with their host plants," contributed to the tenth volume of the Proceedings of the Kansas Academy of Science, but without a description. The name was written "*Aecidium Petalostemonis* Farl.," and during the year following the type collection was issued in Ellis & Ev. N. Am. Fungi as "*Puccinia Petalostemonis* Farl." Since that time it has been variously ascribed to Farlow and to Kellerman & Carleton, or as "I" of *Puccinia Petalostemonis* or *Uropyxis Petalostemonis*. Under the last name Sydow in his Monog. Uredinearum appends a partial description, but without using a distinctive name or positively referring it to *Uropyxis*.

The form can not belong to the life cycle of *Uropyxis Petalostemonis* for numerous reasons. No aecial stage has yet been discovered for any species of that genus. Should one ever be found, it will doubtless have subcuticular pycnia and aecial paraphyses, having no true peridium, as occurs in *Phragmopyxis*, which is simply *Uropyxis* with three-celled teliospores. Beside, *U. Petalostemonis* is known to have a primary uredo accompanied by pycnia, which excludes the likelihood of an aecial stage. Finally both from structure and analogy the form may be considered as part of some heteroecious grass rust.

***Aecidium fluxum* sp. nov.**

O. Pycnia chiefly epiphyllous, few, inconspicuous, subepidermal, honey-yellow, subglobose, small, 75–90 μ in diameter by 66–80 μ high; ostiolar filaments long, 80–112 μ .

I. Aecia chiefly hypophyllous, few, widely separated in indefinite groups, short, small, 0.1–0.2 mm. in diameter; peridium colorless, irregularly lacerate, recurved, peridial cells rhomboidal in longitudinal section, 27–35 μ long, overlapping, outer wall rather thick, 5–7 μ , transversely striate, smooth, inner wall about half as thick, somewhat striate, finely verrucose; aeciospores globoid, 20–25 μ in diameter, wall pale-yellow, thin, about 1 μ , irregularly and rather prominently verrucose.

On *Amorpha canescens* Pursh, Colorado, 1907, H. L. Shantz, communicated by E. W. D. Holway. A delicate and inconspicuous species. It may be remarked that *Aecidium Amorphae* Cooke (Grevillea 6: 137. 1878) is the primary uredo of *Uropyxis Amorphae* (Curt.) Schröt., while the present form is part of a heteroecious species, doubtless one of the grass or sedge rusts.

***Aecidium Boehmeriae* sp. nov.**

O. Pycnia epiphyllous, few in small groups about 1 mm. across, honey-yellow becoming brownish, punctiform, not conspicuous, globose or depressed-globose, small, 70–90 μ in diameter by 50–75 μ high; ostiolar filaments up to 65 μ long.

I. Aecia hypophyllous, gregarious or sometimes in annular groups 2–10 mm. across, on larger discolored spots, short, small, about 0.1 mm. in diameter, rather pale-yellow; peridium colorless, margin erose, recurved, peridial cells rhombic, small, 16–23 μ long, inner wall medium thin, 3–4 μ , moderately verrucose, outer wall medium thick, 5–6 μ , striate, smooth; aeciospores globoid,

often angular, very small, $10-13\ \mu$ in diameter, wall pale-yellow, very thin, $0.5-1\ \mu$, very finely verrucose, appearing smooth.

On *Boehmeria cylindrica* (L.) Willd., Takoma Park, District of Columbia, June 6, 1898, collector uncertain, fungi of the T. A. Williams collection, distributed by the U. S. National Museum. This species is morphologically similar to the common *Aecidium Urticae*, belonging to *Puccinia Caricis*, but scarcely half the size throughout, and with other distinctions. The fungus has been collected in other localities along the Atlantic coast and in Indiana, but no specimens are in the writer's herbarium.

***Caecoma occidentale* sp. nov.**

O. Pycnia amphigenous, scattered, minute, inconspicuous, subcuticular, honey-yellow, hemispherical, $65-100\ \mu$ in diameter by $23-32\ \mu$ high.

I. Aecia from a limited mycelium, hypophyllous, sparsely arranged in two rows on yellow spots occupying part or all of a leaf, roundish to oblong, $0.3-1\ \text{mm.}$ or more long by $0.3-0.4\ \text{mm.}$ wide, soon naked, orange-yellow; peridium wanting; aeciospores catenulate, broadly ellipsoid, $20-24 \times 27-32\ \mu$, wall colorless, medium thin, $1.5-2.5\ \mu$, moderately and rather closely verrucose.

On *Pseudotsuga mucronata* (Raf.) Sudw. (*Pseudotsuga Douglasii* Carr., *Abies Douglasii* Lindl.), Beaver River Valley, British Columbia, alt. 860 meters, July 27, 1907, *E. W. D. Holway*. This rust is interesting as the second foliicolous caecoma on *Pinaceae* in North America. The other occurs on *Tsuga canadensis* in the North Atlantic region. The eastern and western species differ greatly in size of spores, and other characters.

***Uredo Grayiae* sp. nov.**

II. Uredinia amphigenous, scattered, sometimes confluent, roundish, $0.5-1\ \text{mm.}$ across, soon naked, pulverulent, chocolate-brown, ruptured epidermis somewhat noticeable; urediniospores ellipsoid or obovate-ellipsoid, $19-23 \times 32-42\ \mu$, wall dark chestnut-brown, somewhat lighter below, rather thick, $2-2.5\ \mu$, slightly thicker above, $2.5-3.5\ \mu$, moderately verrucose above, smooth along the sides, pores 8 in two transverse zones equidistant from the equator.

On *Grayia spinosa* (Hook.) Moq. (*G. polygaloides* H. & A.), Fallon, Nevada, August 21, 1907, *L. L. Harter 1506*, communicated by C. L. Shear. The species is remarkable in the close

resemblance of the spores to those of some species of *Ravenelia*. The upward thickening of the walls, the distribution of color, pores and sculpturing, are characters when taken together that would indicate a member of the subfamily of *Raveneliatae*, but the family of the host is widely removed from any represented in that group of rusts. Its relationship is, consequently, problematical.

***Uredo inquirenda* sp. nov.**

II. Uredinia amphigenous, scattered or in circinating groups, round, 0.5 mm. across, subepidermal, soon naked, dark cinnamon-brown, pulverulent, ruptured epidermis noticeable; urediniospores oval or obovate, $18-23 \times 28-36 \mu$, wall cinnamon-brown, rather thin, $1-1.5 \mu$, somewhat thicker above, $1.5-2.5 \mu$, evenly and strongly echinulate, pores 8, unevenly spaced in two zones of 4 each, equidistant from the equator; pedicels more or less persistent, slender, usually once or more length of spore; paraphyses none.

On undetermined plant, bearing the local name of "Washington Vine," Auburn, Alabama, December 12, 1889, *Geo. F. Atkinson* 1051. This species, like the preceding one, possesses the characters of the *Raveneliatae*, and for this reason has special interest. The rust appears to have been very abundant, all of the leaves of the collection being well covered with sori. The material came into my hands about three years ago among a lot of undetermined specimens, kindly sent from the herbarium of Cornell University for study. Since that time much effort has been expended to ascertain the probable identity of the host, but without making the slightest advance. Dr. E. M. Wilcox and Prof. J. F. Duggar of Auburn, Ala., have made inquiries and can find no trace of the original plant, or of any plant to which the name of "Washington Vine" is now applied. The collector is unable to recall any helpful information, and other botanists familiar with the southern flora do not recognize it. There are only individual leaves in the collection. These are 4-6 cm. long by 1-2 cm. wide, rather thin, green both sides, smooth, entire, lanceolate, sessile, or narrowed into short petioles. It is probable that the plant is not a native of the southern states, but has been cultivated for ornament.

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